

REMARKS

Claims 11-31 are pending in this application. Claims 6-10 are canceled herein. New claims 27-31 are added. Claims 11, 19 and 26 are amended. Basis for the amendments can be found in the application as originally filed. In particular, basis for amendment to claim 11 can be found in the specification on page 6, lines 1-5. No new matter is added.

THE REJECTION OF CLAIMS 8 AND 9 UNDER 35 U.S.C. §112, SECOND PARAGRAPH

The Office Action alleges that claims 8 and 9 depend from canceled claim 7. Claims 8 and 9 are canceled herein, thereby rendering the objection moot.

THE REJECTION OF CLAIMS 6, 8, 9, 11, 12, 14, 15, 17-22, 25 AND 26 UNDER 35 U.S.C. §102(e)

The Office Action alleges that claims 6, 8, 9, 11, 12, 14, 15, 17-22, 25 and 26 are anticipated by Cabasso *et al.* (U.S. Patent No. 5,992,008). The Office Action alleges that the cited reference discloses a catalyst ink for gas diffusion electrode containing a catalytic material, a membrane plasticizer, and poly(vinylidene fluoride). Applicant respectfully traverses the rejection. Applicant respectfully notes that, the rejection is also traversed with respect to new claims 27-31.

RELEVANT LAW

Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. *In re Spada*, 15 USPQ2d 1655 (Fed. Cir, 1990), *In re Bond*, 15 USPQ 1566 (Fed. Cir. 1990), *Soundscriber Corp. v. U.S.*, 360 F.2d 954, 148 USPQ 298, 301, adopted 149 USPQ 640 (Ct. Cl.) 1966. See, also, *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir.), *cert. denied*, 110 S.Ct. 154 (1989). "[A]ll limitations in the claims must be found in the reference, since the claims measure the invention". *In re Lang*, 644 F.2d 856, 862, 209 USPQ 288, 293 (CCPA 1981). Moreover it is incumbent on the Examiner to identify wherein each and every facet of the claimed invention is disclosed in the reference. *Lindemann Maschinen-fabrik GmbH v. American Hoist and Derrick Co.*, 730 F.2d

1452, 221 USPQ 481 (Fed. Cir. 1984). Further, the reference must describe the invention as claimed sufficiently to have placed a person of ordinary skill in the art in possession of the invention. An inherent property has to flow naturally from what is taught in a reference *In re Oelrich*, 666 F.2d 578, 581, 212 USPQ 323, 326 (CCPA 1981).

Claims 6, 8 and 9

Please note that claims 6, 8 and 9 are canceled herein, thereby rendering the rejection moot.

Claims 11, 12, 14, 15, 17 and 18

Claim 11 is an independent claim and recites:

A process for making an electrode for a fuel cell, consisting essentially of:

- (a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride);
- (b) applying the catalyst ink to at least one side of a substrate; and
- (c) drying the catalyst ink on the substrate.

Claims 12-18 depend from claim 11 and further define the substrate and the catalyst ink.

Disclosure of Cabasso *et al.*

The cited reference by Cabasso *et al.* discloses gas diffusion electrodes for fuel cells prepared by wet and dry phase inversion techniques. The reference discloses a catalytic blend of poly(vinylidene fluoride), and carbon black for preparing the gas diffusion electrodes using wet phase inversion technique. The reference discloses that the catalytic blend can further contain N,N-dimethyl formamide. It further discloses that the gas diffusion electrode is prepared by casting the blend with a doctor's knife onto a carbon substrate to form a film and coagulating the film in a coagulation liquid. The reference describes that the film is dried and painted with a catalyst ink. The reference discloses in examples 1 and 4, a catalytic blend containing carbon black PVF and DMF used to cast a film which is then coagulated and dried to make a gas diffusion electrode. It is described in Example 1 that the electrode is painted with a catalyst layer ink containing polyvinylidene fluoride, propanol, water and Pt on Vulcan VX-72. Example 2 describes a catalytic blend containing Acetylene Black C-100 carbon, DMF and PVF. Example 3 describes a gas diffusion electrode made by casting a film of catalytic blend containing Pt on

activated charcoal, DMF and PVF. The example further describes coagulating and drying the film. Example 5 describes that the coagulated film is cast with a layer of ink containing Pt on Vulcan VX-72, DMF and polysulfone. Example 6 describes a gas diffusion electrode made by a process similar to Example 3 and further discloses poly(vinylpyrrolidone) as a pore filter to control the porosity of the gas diffusion layer. Example 7 describes preparation of two gas diffusion electrodes by the process of Example 1, using two different coagulation liquids.

Differences between the claimed subject matter and the disclosure of Cabasso *et al.*

Cabasso *et al.* does not disclose a process for making an electrode for a fuel cell consisting essentially of providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride); applying the catalyst ink to at least one side of a substrate; and drying the catalyst ink on the substrate. The preparation of gas diffusion electrode by the process disclosed in Cabasso *et al.* requires casting a catalytic blend onto a substrate using doctor's knife and then coagulating it in a coagulation liquid. The reference does not disclose the process of instant claim 11 because the claimed process contains the transition phrase "consisting essentially of". This claim does not allow for the coagulation step disclosed in the process of cited reference. Thus, since the process of the reference requires a coagulation step and such step is excluded from instant claim 11, the instant claim is not anticipated by the disclosure of Cabasso *et al.*

Because claims 12, 14, 15, 17 and 18 depend from claim 11, Cabasso *et al.* does not anticipate any of the claims dependent on claim 11. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claims 19-22 and 25

Claim 19 is an independent claim and recites:

A process for making a membrane electrode assembly for a fuel cell, comprising:

- (a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride);
- (b) applying the catalyst ink to at least one side of a membrane; and
- (c) bonding the membrane to at least one electrode.

Claims 20-22 and 25 depend from claim 19 and further define the process.

Disclosure of Cabasso *et al.*

As discussed above.

Differences between the claimed subject matter and the disclosure of Cabasso *et al.*

Cabasso *et al.* does not disclose a process for making a membrane electrode assembly for a fuel cell wherein a catalyst ink is applied to at least one side of a membrane and the membrane is bonded to at least one electrode. The reference does not disclose that catalyst ink is applied to a membrane.

The reference discloses that the gas diffusion electrode is prepared by using a catalytic blend. It is disclosed that catalyst ink is applied to the electrode. The reference further discloses that the electrode is bonded to a NAFION membrane (column 10, lines 26-30). The reference does not disclose that a catalyst ink is applied to the membrane as required in step (b) of the instantly claimed process.

Thus, Cabasso *et al.* does not disclose every element of claim 19. Because Cabasso *et al.* does not disclose every element of claim 19, Cabasso *et al.* does not anticipate claim 19. Because claims 20-22 and 25 depend from claim 19, Cabasso *et al.* does not anticipate any of the claims dependent on claim 19. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claim 26

Claim 26 is an independent claim and recite:

A fuel cell comprising a membrane electrode assembly, wherein the membrane electrode assembly is made by the process of:

- (a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride);
- (b) applying the catalyst ink to at least one side of a membrane; and
- (c) bonding the membrane to at least one electrode.

Disclosure of Cabasso *et al.*

As discussed above.

Differences between the claimed subject matter and the disclosure of Cabasso *et al.*

Cabasso *et al.* does not disclose a fuel cell containing a membrane electrode assembly wherein the membrane electrode assembly is made by a process that involves applying a catalyst ink to at least one side of a membrane and bonding the membrane to at least one electrode. The reference does not disclose that catalyst ink is applied to a membrane.

The reference describes that the gas diffusion electrode disclosed therein is prepared by using a catalytic blend. The reference further discloses that catalyst ink is applied to the electrode. The reference discloses that the electrode is bonded to a NAFION membrane (column 10, lines 26-30). The reference does not disclose that a catalyst ink is applied to the membrane as required in step (b) of the instantly claimed process.

Thus, Cabasso *et al.* does not disclose every element of claim 26. Because Cabasso *et al.* does not disclose every element of claim 26, Cabasso *et al.* does not anticipate claim 26. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

New Claims 27-31

Claim 27 is an independent claim and recite:

A process for making an electrode for a fuel cell, comprising:

- (a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride); and
- (b) applying the catalyst ink to at least one side of a membrane.

Claims 28-31 depend from claim 27 and further define the process.

Disclosure of Cabasso *et al.*

As discussed above.

Differences between the claimed subject matter and the disclosure of Cabasso *et al.*

Cabasso *et al.* does not disclose a process for making an electrode for a fuel cell wherein a catalyst ink is applied to at least one side of a membrane. The reference discloses that the gas

diffusion electrode is prepared by applying a catalytic blend onto a substrate. It discloses suitable substrates for catalytic blend as carbon substrates including carbon paper, carbon cloth, carbon felt and carbon tape. It is further disclosed that a catalyst ink is applied onto the gas diffusion electrode. The reference does not disclose that a catalyst ink is applied to a membrane as required in the instantly claimed process.

Thus, Cabasso *et al.* does not disclose every element of claim 27. Because Cabasso *et al.* does not disclose every element of claim 27, Cabasso *et al.* does not anticipate claim 27. Because claims 28-31 depend from claim 27, Cabasso *et al.* does not anticipate any of the claims dependent on claim 27. Applicant respectfully requests that the rejection be reconsidered and withdrawn.

REJECTION OF CLAIMS 16 and 24 UNDER 35 U.S.C. §103(a)

The Office Action rejects claims 16 and 24 as being obvious over Cabasso *et al.* as applied to claims 6, 8, 9, 11, 12, 14, 15, 17-22, 25 and 26. The Office Action admits that the reference does not explicitly teach roughening the surface of the membrane prior to applying the catalyst ink. The Office Action alleges that a skilled artisan would have found such a step obvious for reasons such as increasing the surface area.

This rejection is respectfully traversed. Applicant further submits that the rejection is also traversed with respect to new claim 31.

Relevant Law

[I]n order to establish a *prima facie* case of obviousness, there must be evidence, preferably a teaching, suggestion, incentive or inference from the cited art or in the form of generally available knowledge that one of ordinary skill would have been led to modify the relevant teaching to arrive at what is claimed. *In re Papesch*, 315 F.2d 381, 391, 137 USPQ 43, 51 (CCPA 1963).

The prior art must provide a motivation whereby one of ordinary skill in the art would have been led to do that which the applicant has done. *Stratoflex Inc. v Aeroquip Corp.*, 713 F.2d 1530, 1535, 218 USPQ 871, 876 (Fed. Cir. 1983). In addition, the mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification

obvious unless the prior art suggests the desirability of the modification. *In re Fritch*, 23 USPQ 1783 (Fed. Cir. 1992).

The instant claims

Claim 16 depends from claim 12 and further defines the process of claim 12 as containing the step of roughening the surface of the membrane prior to applying the catalyst ink. Claim 12 in turn depends from claim 11 and defines the substrate used in claim 11 as a membrane. Claim 11, as discussed above, is directed to a process for making an electrode for a fuel cell by applying a catalyst ink onto a substrate.

Claim 24 depends from claim 19 and further defines the process of claim 19 as containing the step of roughening a surface of the membrane prior to applying the catalyst ink. Claim 19 is directed to making a membrane electrode assembly for a fuel cell, as discussed above.

Claim 31 depends from claim 27 and further defines the process of claim 27 as containing the step of roughening a surface of the membrane prior to applying the catalyst ink. Claim 27 is directed to making an electrode for a fuel cell, as discussed above.

The teachings of Cabasso *et al.* and the differences from the instant claims

Claim 16

Cabasso *et al.* is directed to gas diffusion electrodes for fuel cells. The reference teaches a catalytic blend that can be applied by casting the blend with a doctor's knife onto a carbon substrate to form a film which is coagulated in a coagulation liquid. The reference teaches carbon paper, carbon cloth, carbon felt and carbon tape as substrates used for casting the catalytic blend. The reference does not teach or suggest any pretreatment, such as roughening, of the substrates used therein.

As discussed above, Cabasso *et al.* does not teach or suggest a process consisting essentially of providing a catalyst ink; applying the catalyst ink to at least one side of a substrate; and drying the catalyst ink on the substrate as claimed in claim 11. Further, Cabasso *et al.* does not teach or suggest any pretreatment, such as roughening, of the substrate before applying the catalytic blend as claimed in claim 16.

A person of ordinary skill in the art would not have been motivated, based on the teachings of Cabasso *et al.*, to roughen the surface of a substrate before applying the catalyst ink as instantly claimed.

There is no motivation, teaching or suggestion in Cabasso *et al.* for roughening the surface of the substrate prior to applying the catalyst ink.

The gas diffusion electrode taught in Cabasso *et al.* are prepared by casting a film of a catalytic blend on a substrate, coagulating the film and drying the coagulated film. The substrates taught in the reference include various carbon substrates. The reference does not teach or suggest any pretreatment, such as roughening, of the substrates used therein.

Cabasso *et al.* fails to teach or suggest roughening the surface of the substrate. Furthermore, Cabasso *et al.* provides no teaching or suggestion for modification of its substrate before applying the catalytic blend onto the surface thereof. Hence Cabasso *et al.* does not teach or suggest the step of roughening the surface of the substrate as claimed in instant claim 16.

Claims 24 and 31

Cabasso *et al.* does not teach or suggest applying a catalyst ink on a membrane as required in the processes of claims 19 and 27. Therefore, it cannot teach or suggest roughening of the membrane before applying the catalyst ink as claimed claims 24 and 31.

A person of ordinary skill in the art would not have been motivated, based on the teachings of Cabasso *et al.*, to roughen the surface of a membrane before applying the catalyst ink as instantly claimed because the reference not teach or suggest applying the ink onto a membrane.

There is no motivation, teaching or suggestion in Cabasso *et al.* for roughening the surface of the membrane prior to applying the catalyst ink.

The gas diffusion electrode taught in Cabasso *et al.* are prepared by casting a film of a catalytic blend on a substrate, coagulating the film and drying the coagulated film. The substrates taught in the reference include various carbon substrates. The reference does not teach or suggest applying a catalyst blend or catalyst ink to a membrane. Therefore, the reference cannot teach or suggest any pretreatment, such as roughening, of the membrane.

Cabasso *et al.* fails to teach or suggest applying catalyst ink to a membrane. Therefore, Cabasso *et al.* cannot provide teaching or suggestion for modification of the membrane before applying the catalytic blend onto the surface thereof. Hence Cabasso *et al.* does not teach or suggest the step of roughening the membrane surface as claimed in instant claims 24 and 31.

Therefore, since there is no motivation or suggestion in the cited reference to do that which Applicant has done (*In re Fritch*), the Office Action has failed to set forth a case of *prima facie* obviousness.

REJECTION OF CLAIMS 10 and 23 UNDER 35 U.S.C. §103(a)

The Office Action rejects claims 10 and 23 as being obvious over Cabasso *et al.* as applied to claims 6, 8, 9, 11, 12, 14, 15, 17-22, 25 and 26, in view of Kindler (U.S. Patent No. 5,992,008). The Office Action alleges that Kindler teaches a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid. Therefore, it is alleged that it would have been obvious to one of ordinary skill in the art to employ such a copolymer in the catalyst ink. Applicant respectfully traverses the rejection.

Relevant Law

In order to set forth a *prima facie* case of obviousness under 35 U.S.C. §103: (1) there must be some teaching, suggestion or incentive supporting the combination of cited references to produce the claimed invention (*ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 USPQ 329, 933 (Fed. Cir. 1984)) and (2) the combination of the cited references must actually teach or suggest the claimed invention. Further, that which is within the capabilities of one skilled in the art is not synonymous with that which is obvious. *Ex parte Gerlach*, 212 USPQ 471 (Bd. APP. 1980). Obviousness is tested by "what the combined teachings of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981), but it cannot be established by combining the teachings of the prior art to produce the claimed subject matter, absent some teaching or suggestion supporting the combination (*ACS Hosp. Systems, Inc. v Montefiore Hosp.* 732 F.2d 1572, 1577. 221 USPQ 329, 933 (Fed. Cir. 1984)). "To imbue one of ordinary skill in the art with knowledge of the invention in suit, when no prior art reference or references of

record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher" *W.L. Gore & Associates, Inc. v. Garlock Inc.*, 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983).

The instant claims

Claim 10 is canceled herein, thereby rendering the rejection moot. Claim 23 is directed to the process of claim 19 and further defines the process as containing the step of adding to the catalyst ink a second ionomer comprising a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid.

Teachings of Cabasso *et al.*

As discussed above.

Teachings of Kindler

Kindler teaches a catalyst ink that has three components: catalyst, polytetrafluoroethylene and NAFION (copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid) solution. The reference further teaches that NAFION, the third component of the catalyst ink cannot tolerate high temperatures required in preparing the membrane electrode assembly. The reference teaches that **NAFION is removed from the ink**. The catalyst ink is applied onto an electrode backing and the catalyst coated electrode is subjected to high temperatures. The reference teaches that the **NAFION is applied separately** after the electrode has cooled (see column 6, lines 28-52).

ANALYSIS

The Office Action fails to establish that the instant claims are *prima facie* obvious over Cabasso *et al.* in view of Kindler for the following reasons.

The combination of teachings of Cabasso *et al.* with the teachings of Kindler does not result in the instantly claimed process.

As discussed above, Cabasso *et al.* teaches gas diffusion electrodes prepared by wet and dry phase inversion technique. It does not teach or suggest the process of claim 23 for making a membrane electrode assembly for a fuel cell wherein a catalyst ink containing a catalytic material, poly(vinylidene fluoride) and a ionomer containing a liquid copolymer of

tetrafluoroethylene and perfluorovinylethersulfonic acid; applying the catalyst ink to at least one side of a membrane; and bonding the membrane to at least one electrode. Cabasso *et al.* neither teaches or suggests a catalyst ink that contains a catalytic material, poly(vinylidene fluoride) and a second ionomer containing a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid, nor does it teach or suggest the step of applying the ink to at least one side of a membrane.

Kindler does not cure this defect. Kindler teaches a catalyst ink for application **onto an electrode**. It does not teach or suggest a catalyst ink containing a catalytic material, poly(vinylidene fluoride) and a second ionomer containing a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid that can be applied to at least one side of a membrane. In fact, Kindler **teaches away** from using NAFION in the catalyst ink. The reference teaches that NAFION is removed from the ink to prevent destroying NAFION at high temperatures required in the process used by Kindler. The reference teaches that NAFION is separately applied onto the electrode after cooling.

Hence, Kindler does not teach a catalyst ink containing a catalytic material and poly(vinylidene fluoride) and a ionomer containing a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid that is applied to at least one side of a membrane, and, in fact, **teaches away from using a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid in the catalyst ink**. Thus, the combination of the teachings of Cabasso *et al.* and Kindler does not result in the instantly claimed subject matter, which includes a catalyst ink containing a catalytic material, poly(vinylidene fluoride) and a ionomer containing a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid that can be applied to at least one side of a membrane. Therefore, the Office Action has failed to set forth a *prima facie* case of obviousness.

REJECTION OF CLAIM 13 UNDER 35 U.S.C. §103(a)

The Office Action rejects claim 13 as being obvious over Cabasso *et al.* as applied to claims 6, 8, 9, 11, 12, 14, 15, 17-22, 25 and 26, in view of Scherer *et al.*(U.S. Patent No. 5,656,386). The Office Action alleges that the reference teaches sulfonated and fluorinated

membrane materials. It is urged that it would have been obvious to one of ordinary skill in the art to employ a PSSA-PVDF membrane for reasons such as improved long term thermal and temporal stability. Applicant respectfully traverses the rejection.

Relevant Law

As discussed above.

The instant claims

Claim 13 depends from claim 12. Claim 12 in turn depends on claim 11, which as discussed above, is directed to a process for making an electrode for a fuel cell, containing the steps of providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride); applying the catalyst ink to at least one side of a substrate; and drying the catalyst ink on the substrate. Claim 12 defines the substrate as a membrane and claim 13 further defines the membrane of claim 12 as a PSSA-PVDF membrane.

Teachings of Cabasso *et al.*

As discussed above.

Teachings of Scherer *et al.*

Scherer teaches an electrochemical cell. Scherer teaches various polymers that can be used as membrane materials for use in electrochemical cells and fuel cells.

ANALYSIS

The Office Action fails to establish that the instant claims are *prima facie* obvious over Cabasso *et al.* in view of Scherer *et al.* for the following reasons.

The combination of teachings of Cabasso *et al.* with the teachings of Scherer *et al.* does not result in the instantly claimed process.

As discussed above, Cabasso *et al.* teaches gas diffusion electrodes prepared by wet and dry phase inversion techniques. It does not teach or suggest the process of claim 16 for making an electrode for a fuel cell wherein a catalyst ink containing a catalytic material, and poly(vinylidene fluoride) is applied to at least one side of a PSSA-PVDF membrane; and the ink is dried on the PSSA-PVDF membrane. Cabasso *et al.* neither teaches or suggests a catalyst ink

that can be applied to at least one side of a PSSA-PVDF membrane, nor does it teach or suggest that the ink is dried on the PSSA-PVDF membrane.

Scherer *et al.* does not cure this defect. Scherer *et al.* teaches membranes for electrochemical cells and fuel cells. It does not teach or suggest gas diffusion electrodes prepared by applying a catalyst ink to at least one side of a PSSA-PVDF membrane; and drying the ink on the PSSA-PVDF membrane.

Hence, Scherer does not teach a process for making gas diffusion electrodes prepared by providing a catalyst ink containing a catalytic material and poly(vinylidene fluoride); applying the ink to at least one side of a PSSA-PVDF membrane; and drying the ink on the PSSA-PVDF membrane. Thus, the combination of the teachings of Cabasso *et al.* and Scherer *et al.* does not result in the instantly claimed subject matter, which includes a catalyst ink containing a catalytic material, and poly(vinylidene fluoride) that can be applied and dried to at least one side of a PSSA-PVDF membrane. Therefore, the Examiner has failed to set forth a *prima facie* case of obviousness.

Response to the Advisory Action

It is alleged in the Advisory Action that the Amendment after Final, filed on March 17, 2004, was not be entered because it would allegedly require further consideration and prior art search.

The Advisory Action alleges that the recitation of the transition phrase "consisting essentially of" in claims would require further consideration and search. Applicant respectfully submits that the addition of the transition phrase "consisting essentially of" in claims 11 and 16 clarifies the subject matter encompassed by the claims and places the claims in condition for allowance.

* * *

Applicant : S. R. Narayanan, et al.
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In view of the amendments and remarks herein, reconsideration and allowance of the application are respectfully requested.

Applicant hereby petitions under 37 C.F.R. §1.136 for two (2) months extension of time. A check in the amount of \$540.00 including \$385 for the RCE, and \$155 for a two-month extension of time (\$210-\$55 previously paid) is enclosed. Please apply any other charges, or any credits, to Deposit Account 06-1050.

Respectfully submitted,

Date: 4/19/04



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